CLAIMS

I claim:

1. A gas and oil well proppant comprising a mixture of:

a) from about 1% by weight to about 10% by weight talc;

b) from about 1% by weight to about 10% by weight wollastonite;

c) from about 5% by weight to about 33% by weight bauxite;

d) from about 10% by weight to about 65% by weight quartz; and

e) from about 10% by weight to about 65% by weight shale;

wherein the mixture has an alumina content of less than about 25% by weight, and a silica content of greater than about 45% by weight.

2. The proppant of claim 1 wherein the bauxite, quartz and shale are present in equal amounts.

3. The proppant of claim 1 wherein the overall percentage of silica in the mixture is from about 45% by weight to about 70% by weight.

4. The proppant of claim 3 wherein the overall percentage of silica in the mixture is from about 50% by weight to about 65% by weight.

5. The proppant of claim 1 wherein the shale contains from about 5% by weight to about 10% by weight potassium oxide and from about 75% by weight to about 90% by weight silica.

6. The proppant of claim 1 wherein the mixture contains from about 3% by weight to about 10% by weight Fe_2O_3.

7. The proppant of claim 1 wherein the mixture contains from about 10% by weight to about 30% by weight Al_2O_3.

8. The proppant of claim 7 wherein the mixture contains from about 15% by weight to 25% by weight Al_2O_3.

9. The proppant of claim 1 wherein the bauxite comprises from about 40% by weight to 70% by weight Al_2O_3 and from about 15% by weight to about 35% by weight Fe_2O_3.

10. The proppant of claim 1 wherein the bauxite is uncalcined.

11. The proppant of claim 1 wherein the mixture comprises pellets having a diameter from about 0.5 mm to about 2 mm.

12. The proppant of claim 1 wherein the combined percentage of the talc and wollastonite in the mixture is less than about 10% by weight of the mixture.

13. A proppant composition for use in gas and oil wells, comprising a mixture of:

(a) a hydraulic fluid; and

(b) a proppant particulate material comprising a mixture of

(1) from about 1% by weight to about 10% by weight talc;

(2) from about 1% by weight to about 10% by weight wollastonite;

(3) from about 5% by weight to about 33% by weight bauxite;

(4) from about 10% by weight to about 65% by weight quartz; and

(5) from about 10% by weight to about 65% by weight shale;

wherein the mixture has an alumina content of less than about 25% by weight, and a silica content of greater than about 45% by weight.

14. The proppant composition of claim 13 wherein the bauxite, quartz and shale are present in equal amounts.

15. The proppant composition of claim 13 wherein the overall percentage of silica in the mixture is from about 45% by weight to about 70% by weight.

16. The proppant composition of claim 15 wherein the overall percentage of silica in the mixture is from about 50% by weight to about 65% by weight.

17. The proppant composition of claim 13 wherein the shale contains from about 5% by weight to about 10% by weight potassium oxide and from about 75% by weight to about 90% by weight silica.

18. The proppant composition of claim 13 wherein the mixture contains from about 3% by weight to about 10% by weight Fe_2O_3.

19. The proppant composition of claim 13 wherein the mixture contains from about 10% by weight to about 30% by weight Al_2O_3.

20. The proppant composition of claim 19 wherein the mixture contains from about 15% by weight to 25% by weight Al_2O_3.

21. The proppant composition of claim 13 wherein the bauxite comprises from about 40% by weight to 70% by weight Al_2O_3 and from about 15% by weight to about 35% by weight Fe_2O_3.

22. The proppant composition of claim 13 wherein the bauxite is uncalcined.

23. The proppant composition of claim 13 wherein the mixture comprises pellets having a diameter from about 0.5 mm to about 2 mm.

24. The proppant composition of claim 13 wherein the combined percentage of the talc and wollastonite in the mixture is less than about 10% by weight of the mixture.

25. The proppant composition of claim 13 wherein said hydraulic fluid is selected from the group consisting of oil, water and mixtures thereof.

26. A method for forming a proppant formed of a composite, sintered, generally spherical pellets, the method comprising the steps of:

a) preparing a mixture of equal parts of sized powders of bauxite, quartz, shale, and adding a binder of talc and wollastonite to said mixture in an amount of less than about 10% by weight of the mixture;

b) adding an amount of starch and water to the mixture;

c) forming the mixture into a number of generally spherical particles; and

d) heating the particles to sinter the particles.

27. The method of claim 26 wherein the step of forming the mixture into a number of spherical particles further comprises the steps of:

a) placing the mixture into a high intensity mixer;

b) operating the mixer; and

c) removing the particles from the mixer.

28. The method of claim 27 wherein the step of operating the mixer further comprises the steps of:

a) running the mixer at a first speed to thoroughly homogenize the mixture; and

b) running the mixer at a second speed to form the particles into a desired size.

29. The method of claim 28 wherein the first speed is faster than the second speed.

30. The method of claim 26 wherein the step of forming the mixture into a number of spherical particles further comprises the steps of:

a) forming an aqueous feed suspension comprising the mixture of the starch and the water;

b) continuously atomizing the feed suspension into a layer of partly dried particles fluidized in a stream of drying air;

c) continuously recovering particles from the layer;

d) continuously separating the recovered particles into oversized, undersized and product fractions, making allowance for shrinkage in the subsequent sintering operation; and

e) continuously recycling material selected from the group consisting of undersized fractions, relative fine product fractions, ground oversize fractions, and ground product fractions to the layer of fluidized particles at a site a substantial distance from the location where recovering of particles takes place, measured along the flow path of the particles.

31. The method of claim 30 wherein the material recycled in step (e) has been ground to a desired particle size distribution.

32. The method of claim 30 wherein the stream of drying air fluidizing the particles has a velocity of 0.5 m/s to 1.5 m/s.

33. The method of claim 26 further comprising the step of drying the particles to remove water after forming the mixture into the particles.

34. The method of claim 33 wherein the step of drying the particles further comprises the steps of:

a) placing the particles into a container having an open top; and

b) allowing the particles to dry under ambient conditions.

35. The method of claim 33 wherein the step of drying the particles further comprises the steps of:

a) placing the particles into a rotary dryer; and

b) operating the dryer.

36. The method of claim 26 wherein the step of heating the particles to sinter the particles comprises the steps of:

a) placing an amount of the dried particles into a rotary kiln; and

b) heating the particles to a sintering temperature for a specified time to sinter the particles into the pellets.

37. The method of claim 36 wherein the temperature to which the particles are heated is between 1100°C and 1200°C.

38. The method of claim 26 wherein the step of heating the particles to sinter the particles comprises the steps of:

a) feeding the particles into an inlet of a microwave sintering apparatus; and

b) irradiating the particles as they pass through the apparatus to sinter the particles and form the pellets.

39. The method of claim 38 wherein the temperature to which the particles are heated is between 1100 and 1200°C.

40. The method of claim 38 wherein the microwave sintering apparatus is a continuous feed apparatus.

41. The method of claim 40 wherein the microwave sintering apparatus is a fluidized microwave bed.

42. A method of increasing the permeability of a fracture of a gas or oil well by pumping the proppant of claim 1 into the fracture.

43. A method of increasing the permeability of a fraction of a gas or oil well by pumping a proppant formed by the method of claim 26 into the fracture.